EX 2000

Disk Drive Exerciser Manual

Proto PC, Inc.

JACKSON

NOTES:

① AFTER INSERTING SCRATCH DISKETTE, TAKE DISKETTE OUT & FLIP WRITE PROTECT ON DISKETTE. TRY TO WRITE OR ERASE ON SCRATCH DISKETTE W/WRITE PROTECT ON. VERIFY TO MAKE SURE DISKETTE DRIVE IS NOT STUCK IN WRITE MODE,

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IMPORTANT LEGAL NOTICE: All of the following are Copyright 1983-1989 by Proto PC, Inc.

This manual, the front and back panels of the EX2000 itself, the schematic diagram describing the construction of the EX2000, the ROM software code inside the EX2000 describing it's sequence of operations, and the printed circuit board layout of the EX2000 are all licensed exclusively to Proto PC, Inc., and may not be copied, used, or divulged by anyone without express written permission.

1 Overview

Please take a few minutes to read and understand the cautions noted herein. The EX2000 is a high quality, conservatively designed instrument, but it is possible to damage it through improper hookups. See section 2, Setup, for Cautions. See section 7 for warranty policy.

1.1

The EX2000: A microprocessor based test instrument used to align and repair floppy disk drives with industry standard SA400 and SA800 interfaces. The unit is used with an oscilloscope, an alignment disk, and a service manual for the drive under test. The EX2000 'exerciser' is the stimulus to the drive. It's capable of moving the R/W head to any track with a single keystroke, writing or erasing a track, measuring the rotational speed of the drive, checking for hysteresis, etc. The alignment disk provides the reference waveforms, the service manual tells you what to adjust and how to measure it, and the 'scope is the visual feedback for aligning the drive to spec.

1.2 Unique Features:

- Single keystroke for any alignment track.
- Hysteresis check with a single key.
- Speed check (instantaneous and average)
- Easy scope hookup with test points for INDEX, RD DATA, WR DATA, MOTOR ON
- Top quality European key switches and gold connectors
- This is the fastest, easiest to use exerciser on the market.
- The only exerciser designed for service people, by service people

1.3 What you'll need besides the EX2000:

- You'll need a power supply, power and data cables, alignment disks, a decent scope (dual trace w/invert and add), **a service manual for the drive under test**, and enough knowledge to use the above intelligently.

1.4 Drives it works with:

Any floppy with standard control lines similar to the SA400 or SA800 industry standard. In other words, if the drive works in an IBM PC, Kaypro, TRS80, etc., then the EX2000 will test it.

1.5 The only way to 'final test' a drive...

is with a computer that formats, writes, and reads actual data records, and can keep a statistical error log. The EX2000 has the capability to write a data pattern to the drive, but it's meant only for exercising the electronics, not for error checking. We sell a drive performance analyzer program for IBM PC's that's ideal for doing final test. Please call and ask us about the 'Interrogator Program'.

1.6 EX2000 owners include:

NASA, FAA, Xerox, Inderserv, Computerland, RCA, CBS, ABC, IBM, Army, Navy, and thousands of computer dealers, universities, and individuals.

1.7 We also sell and support:

- Floppy and Hard Disk Drives
- 386 and 286 Computer Systems
- High Resolution Graphics Displays
- Memory IC's, boards, and upgrades
- Please call and ask us about any of the above
- We're also very happy to handle export on any of these items.

2 Set-up

2.1 You Must:

Use the SAME power supply to power both the drive under test and the EX2000!!! Be careful about hooking up power. Make SURE that the +5 volts and ground are properly connected. The 'Y' power cables we sell will give you the proper hookups with a minimum of hassle for drives that use standard 4-pin AMP connectors, e.g., SA400, TM100, IBM PC, TRS80, etc. Be careful hooking up the drive data cable. Make sure the pin 1's are oriented correctly.

2.2 Connecting Power:

Using Proto PC 'Y' power cables, plug the cable from the power supply into the junction of the 'Y' cable. Plug one end of the 'Y' cable into the drive and the other end into the EX2000. The 5" drive 'Y' cable connects all four wires (+5, two grounds, +12), and the 8" drive 'Y' cable connects +5 and ground only. Make sure the jumpers on the right side of the EX2000 are set right. See the "Jumpers" section below.

2.3 Connecting the Drive:

Next, attach the data cable from the EX2000 to the drive. MAKE SURE you get the connector on the right way. Pin 1 on the EX2000 (marked on the PC board next to the copyright) MUST go the Pin 1 on the drive. See illustration in the "Jumpers" section.

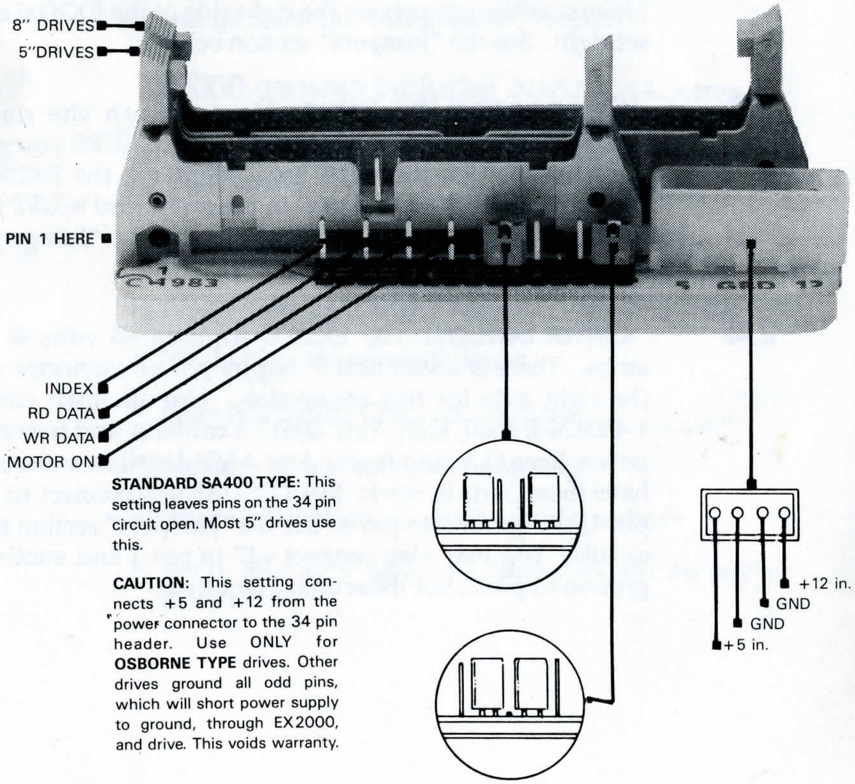
2.4 Other Setups:

The EX2000 requires +5 volts @ .5 amps. There is a standard 5" floppy power connector on the right side for this connection. Use an AMP part# 1-480424-0 shell, with AMP 60617-1 contacts, and fuse the power lines (1.5 amp fuse). Any AMP distributor should have these parts in stock. MAKE SURE you connect +5 to pin 4, and ground to pin 3. See the "Jumpers" section for details. You may also connect +12 to pin 1 and another ground to pin 2, but these aren't required.

3 Jumpers

We ship the unit with all odd pins on the 34 pin header grounded or open. Using the two jumpers, you can connect +5 to pins 21/23/25/27, and +12 to pins 11/13/15/17 on the 34 pin. This setup is used for 'Osborne' drives or the Proto PS2 adaptor, which get power through the data cable. However...

- CAUTION!!! Most drives tie these pins to ground. If you jumper the unit for Osborne or PS2, and connect it to a normal drive, you'll SHORT THE POWER SUPPLIES, *through the EX2000.* This will burn up the drive and power supply and VOID YOUR WARRANTY,
- BE CAREFUL! Before you hook up a drive; be sure the jumpers are set correctly! **Jumpers are spread apart (2 pins showing between jumpers) for normal operation.** Jumpers are next to each other for Osborne.



STANDARD SA400 TYPE: This setting leaves pins on the 34 pin circuit open. Most 5" drives use this.

CAUTION: This setting connects +5 and +12 from the power connector to the 34 pin header. Use ONLY for **OSBORNE TYPE** drives. Other drives ground all odd pins, which will short power supply to ground, through EX2000, and drive. This voids warranty.

4 Keyboard layout

There are three kinds of command keys: FUNCTION, SELECT, and HEAD MOVE. The Function keys execute a function, the Select keys select an operating mode, and the Head Move keys issue step pulses to move the head.. Six Head Move keys select preprogrammed track numbers from a track table in ROM, and two 'Jog' keys let yo step or slew to any track.

Function keys

4.1 **Side:** Pressing the SIDE key toggles the SIDE output line, and shows the current side on the display for 1 second. The SIDE LED should also light if you have selected side 1

4.2 **Speed:** This function measures the time between INDEX pulses and displays it in milliseconds. The 'tens' and 'ones' digits are shown. When the value approaches 200 ms (199 or 201 ms, 99 or 01 on display) the display will switch to 'ones and tenths' (90 or 09 on display) for fine adjustment. Speed will be displayed until any other key is pressed. If SPEED is pressed a second time while already in SPEED mode, the display will switch from constant update, to 16 sample running average. This smooths the reading, allowing very precise adjustment of 5" drives. Normal reading on 8" drives will be 65-67, indicating a timing of 166 ms. If the INDEX pulse is missing (bad sensor, door open, etc.) the display will flash '88'.

4.3 **HYST** 'Hysteresis' is a mechanical problem where the head settles off track at the end of a seek. It's usually caused by sticky or dirty rails, loose or kinked band positioners, etc.. The HYST key steps the head 10 tracks in, then back. The next press of HYST steps 10 tracks out and back. When used with a scope and the CATSEYE track on an alignment disk, a change of relative lobe heights clearly shows hysteresis.

4.4 **Motor On:** This key toggles the MOTOR ON output line. There's a test point on the right side of the EX2000 to monitor this line with a scope. See the "Jumpers" section for location.

4.5 **Write:** This key writes a track for 150ms with a square wave. Data is issued on the WRITE DATA line while WRITE GATE is pulled low-true. Error messages include: Flashing '99' for WRITE PROTECT. This can be used as a test of the WRITE PROTECT sensor and circuit.

4.6 **Erase:** When this key is pressed, the EX2000 erases the track. WRITE GATE is pulled low-true for 150ms without sending any data on the WRITE DATA line. To completely erase a track, press two or three times. If WRITE PROTECT is true, the '99' will flash on the display.

Select Keys

4.7 **Step Rate:** When pressed, it shows the current STEP RATE on the display for one second, then the display switches back to showing TRACK #. If pressed again within that one second, the display will advance to the next choice. Choices are 3-30ms in 3ms steps. The power-up default is 9ms.

4.8 **Drive Type:** This key works like STEP RATE, but changes the track tables for the Head Move keys. These tables program the bottom row of keys to the proper track numbers for the alignment disk for a particular drive type. The types are as follows:

Display	Type of Drive	Alignment Disk
"31"	3.5" drives	Proto # DK3502A
"51"	5" 48 tpi, like IBM 360K format	Proto # DK2242A
"52"	5" 96 tpi Hi-Density, 1.2mb AT	Proto # DK20634
"53"	5" 96 tpi old 720K format	Proto # DK20630
"54"	5" 100tpi Micropolis/Tandon	Proto # DK20630
"81"	8" 48tpi standard 8" format	Proto # DK2402A or DK3602A

Head Move Keys

4.9 **Alignment Tracks** The first six keys in the bottom row let you access all common alignment tracks with a single keystroke. They're programmed for the industry standard alignment disks supplied by Proto PC, as detailed in the above table. We can supply these disks for virtually any drive.

4.10 **TRK 0** Moves the head out until the TRACK 0 line goes true, or 99 step pulses have been issued over the interface.

4.11 **Index, Catseye, Read Res, Azim, Top Trk:** These keys move the head to the proper track number to view these alignment waveforms.

4.12 **Jog Keys:** These keys will move the head in and out one track per press, or slew the head continuously if held down more than a half second.

5 Using the EX2000

Note: We suggest starting with a "known good" drive to familiarize yourself with the EX2000 and alignment procedures.

5.1 **Caution:** It's a good idea to use a scratch disk first, and verify that the R/W circuitry works properly BEFORE using an expensive alignment disk. If the drive is stuck in "write" mode, the $60 alignment disk will be ruined the instant you shut the door. Hook up the power and data cables, making sure to connect power properly and get the pin 1's on the right way.

5.2 **Summary of Steps:** Hook up the scope to the read amp test points on the drive, and set the scope controls properly. A service manual for the drive you're working on will describe this procedure in detail. Please note the following:

5.3 **Get a service manual:** **We can't give you exact procedures here because there are literally hundreds of manufacturers and models of disk drives. This manual would be the size of a file cabinet if we tried to include every one.** ***Please contact the drive manufacturer directly for service manuals.*** **Thank you for your understanding. For your convenience, some suggestions are printed here, but we can't answer any drive-specific questions beyond these notes:**

5.4 **How to Set the Scope:** Set your dual-trace scope so that both channels are an AC coupled line in the middle of the screen, on top of each other. Set the gain for about 100mv per division (including x10 probe, if any) and set the Horizontal Sweep to 50ms per division. Now set the Vertical mode to "ADD" (one line centered on screen) and invert one channel. Set the scope to trigger from the third channel or the EXT TRIGGER input, and hook this third probe up to the INDEX testpoint on the side of the EX2000 (convenient, eh?). This will sync the scope trace to the rotation of the drive and gives you one clean, stable pattern on the screen.

5.5 **Finding Test Points:** Hook up the Channel 1 and 2 probes to the READ test points on the drive. If you don't have a manual, find the input where the R/W head connects to the circuit board and look for an IC close to it. Now look for two identical inductors next to that IC. Usually they look like resistors, but the color code is funny and the bodies are usually a different color than all the resistors on the board. Hook the probes to either end of these inductors (same end for both probes). If this doesn't help you, **you really need to get the right service manual direct from the manufacturer.** Persistence pays off here. Good luck.

5.6 **Start with a Scratch Disk:** Now insert a scratch disk in the drive and turn on the power supply. The head should move to TRACK 0, and the EX2000 display should light up with "00". Note: Some power supplies (IBM PC, etc.) have a very slow turn-on time that confuses the EX2000 power-on reset circuit, and the EX2000 may not reset properly. If the display doesn't light up, try connecting the power cable to the EX2000 after turning on the supply.

Use the DRIVE TYPE select key on the EX2000 to setup for the kind of drive you're working on. See the DRIVE TYPE description for details.

Press the MOTOR ON key. On 5" drives this will start the motor. On 8" drives this activates the HEAD LOAD line and should turn on the head load solenoid on the drive (click!). At this point, there should be an INDEX pulse 5 or 6 times per second, and you can adjust the scope for solid triggering.

Press the WRITE key. A band of signal should appear on the scope screen. If you don't get the band, or if it just flashes on the screen, the drive may be stuck in write mode. Try to use a 'known good' drive your first time through.

Press the ERASE key. Most of the band should disappear. PRessing the ERASE key several times erases the entire track.

5.7 **Alignment:** Now that the R/W circuit has been verified, the alignment disk can be used to align the drive. Pull the scratch disk and insert the proper alignment disk. Proto PC can supply any alignment disk. Please call us for ordering information. You should now see a band on the screen again, since you're still on track 0, and most alignment disks have a pattern written there.

Press the CATSEYE button. The head will move to the proper track and the two lobes will appear on the screen. You may have to adjust the scope triggering to stabilize the pattern. If the two lobes are of equal height, the drive is in proper radial alignment. The service manual will tell you how unequal the lobes can be without violating spec. Generally if the smaller lobe is within 90% of the larger one, the alignment is OK.

Press the HYST key; now press it again. Did the relative heights of the lobes change? If so, the drive mechanism is faulty. Try cleaning or adjusting tension. A little hysteresis (a few percent of height) won't hurt, but a large amount will cause seek or read errors.

Note: Most drives have adjustments for Radial Alignment, Index Timing, Track 0 sensor position, and Compliance (load pad position and pressure). Azimuth problems are usually caused by a poorly machined frame and most drives don't have any provision for adjusting the Azimuth on the lower head. On two-sided drives, the Azimuth of the upper head can be adjusted along with it's radial alignment, and in fact, they must be adjusted at the same time. This is a touchy procedure. Take your time and consult your service manual. After you do it about 10 times you'll be an expert.

The INDEX timing and other procedures are too detailed and drive specific to describe here. The service manuals and alignment disk manuals will detail these procedures.

6 Appendix

Input/Output Specifications

6.1 **Power specifications:** The EX2000 uses +5 volts only, at a current draw of .5 amps max. A +12 volt connection is provided for Osborne type drives, but it's not required for operation of the EX2000 itself. See the picture in the "Jumpers" section for pin connections. They're also marked on the EX2000 board by the connectors.

6.2 **Outputs:** Are 7406 open collector TTL, with 1k pullups to +5 volts, except SIDE, which is pulled up to +5 through 150 ohms and an LED.

6.3 **Inputs:** Are 74LS14 TTL inputs with 1K ohm pullups to +5 volts, except TK00, INDEX, READY, and WRITE PROTECT, which are pulled up to +5 volts through 150 ohms and an LED.

Data Cable Pinouts

Signal Name	34 pin	50 pin	Notes
Drive Select 1,2,3	10/12/18	26/28/30	Tied to ground
Motor ON/Head Load	16	18	Output of EX2000
Side	32	14	Output of EX2000
STEP	20	36	Output of EX2000
Direction	18	34	Output of EX2000
Write Gate	24	40	Output of EX2000
Write Data	22	38	Output of EX2000
INDEX	08	20	Input to EX2000
TRACK 00	26	42	Input to EX2000
Write Protect	28	44	Input to EX2000
Ready		22	Input to EX2000

- INDEX, RD DATA, WR DATA, MOTOR ON connect to test points on the right end of the EX2000.
- All other even numbered pins left open circuit on the headers.

6.4 8" Connector Grounding:

- All odd numbered pins on the 50 pin 8" connector are tied to ground.

6.5 5" Connector Grounding:

- Pins 1, 3, 5, 7, 9, 19, 27, 29, 31, 33 are tied to ground
- Pins 11, 13, 15, 17 can be jumpered OPEN or to +12 volts.

Open as shipped from factory - USE CAUTION!!

- Pins 21, 23, 25, 27 can be jumpered OPEN or to +5 volts.

Open as shipped from factory - USE CAUTION!!

7 Warranty:

7.1 **Company Policy:** Proto PC has been serving customers for over 12 years. We believe in honest and fair dealings, and usually give the customer the benefit of the doubt. We courteously and quickly honor *valid* warranty claims. However we do NOT honor claims for EX2000's that have been connected to the power supply wrong, etc.. This type of damage is obvious to us upon inspection.

7.2 **One year warranty:** Proto PC of St. Paul, MN warrants that this EX2000 shall be free of defects in material and workmanship. This warranty is good for a period of twelve months from the date of shipment on EX2000's and cables. Please report any defects promptly, and Proto PC will repair or replace (with same or equivalent product) within 30 days from the date we receive the defective product back.

7.3 **Alignment Disks:** Since these products are very easily damaged, and are serial numbered and 100% tested by the manufacturer, and shipped in sealed containers, Proto PC does not warranty alignment diskettes. In our twelve years of experience with literally thousands of alignment diskettes, we've never received a bad one from the manufacturer. However, we've seen plenty that were instantly damaged by insertion in a defective floppy drive, or by a magnetic tool set down on top of them. Treat your disks with care! If you still feel you got a bad diskette, contact the alignment disk manufacturer directly.

7.4 **Call for Return Authorization:** Before we can accept any returns for repair or replacement, we require that you call us and obtain a Return Merchandise Authorization Number. You are responsible for returning the product to Proto PC freight-prepaid and at your own risk. Proto PC will be responsible for returning the product to you via UPS ground rate prepaid in the continental US. Freight outside this area will be charged at the current cost.

7.5 **You Are Responsible For SAFE Shipment:** All products returned to Proto PC under this Warranty MUST be properly packed to protect them during shipment, or no repair replacement or refund will be given. Return shipment in original container is highly recommended. If this is not possible, then we advise that you call us for packaging recommendations. Electronic goods are easily damaged by static electricity and shock. If product is not properly packed, in Anti-static bags, we reserve the right to void this Warranty.

7.6 **Proof of Purchase:** *You* must provide a copy of the purchase invoice as proof of purchase date to receive repair or replacement under this warranty. This is solely your responsibility. Please don't ask us to search through files for your invoice. If the product is serial numbered, then the number must match with the serial number marked on the invoice, or no warranty service will be honored.

7.7 **To Protect Your Warranty:** This warranty is void if product has been subjected to improper installation, misuse, accident, neglect, or repair by purchaser or any third party. Basically, if you take it apart or touch it with a soldering iron, all warranties are void. If you connect it to improper power supplies and blow out every chip, we are not going to fix it free under the warranty! Proto PC will not be responsible for any consequential damages arising from the purchase or use of it's products.

CABLE FOR 3.5 DISKS

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